The D-Light P System

For the fluorescence-supported assessment of perfusion

Introduction

Intravenously administered dyes that strictly remain within the vascular system have been in increasing use in the past several decades to enable a better assessment of normal and pathological states of various tissues or organs in living organisms. Indocyanine green (ICG) is an important representative of this group and features much better pharmacokinetic properties than conventional markers such as fluorescein; anaphylactic reactions or other intolerance reactions are very rarely observed with ICG. The dye, which is rapidly eliminated via the liver without being metabolized, is commonly used in choroidal circulation diagnostics, but it has also been approved for liver function diagnostics and for assessing various cardiovascular and microvascular situations. The promising results of preliminary animal testing suggested that in vivo ICG angiography may also be suitable for non-invasively assessing the postoperative perfusion status of free-flap grafts[1--4].

Application areas

With the novel D-LIGHT P system from KARL STORZ, the applications of ICG angiography have now been expanded to include all endoscopically accessible body regions and a multitude of conceivable new indications. As an example, we will discuss in more detail the ICG fluorescence angiography for the assessment of free-flap grafts in the upper aerodigestive tract. This application has already shown promising results in a feasibility study conducted at our facility[5.6]. Other promising application areas include the diagnostics of highly vascularized neoplasms in the gastrointestinal tract[7.8], the verification of normal blood flow after neurosurgical closure of aneurysms[9], and the intraoperative perfusion assessment in colorectal anastomoses[10] .

Procedure

As an example, we will now describe one of the above indications in more detail. A feasibility study conducted at the ENT department of the LMU University Medical Center was designed to clarify whether after the intravenous administration of ICG, endoscopic fluorescence angiography is suitable for the early detection of reduced tissue perfusion in free-flap tissue grafts in the upper aerodigestive tract that were transferred by microvascular anastomosis. The study is relevant since there are currently no routine procedures for the objective assessment of perfusion in free tissue flaps, despite the fact that an unidentified postoperative disturbance in perfusion may lead to partial or even complete loss of the graft. The study included 25 patients with such tissue grafts. Three endoscopic ICG angiographies were performed in each patient (intraoperatively, 24 hours after surgery, and 72 hours after surgery, see Figs. 1–4).

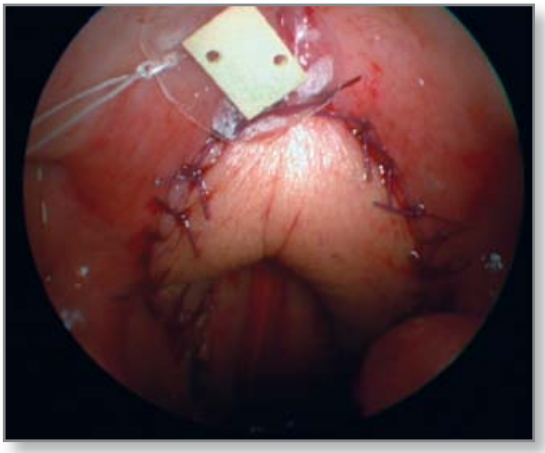

Fig. 1: White light image

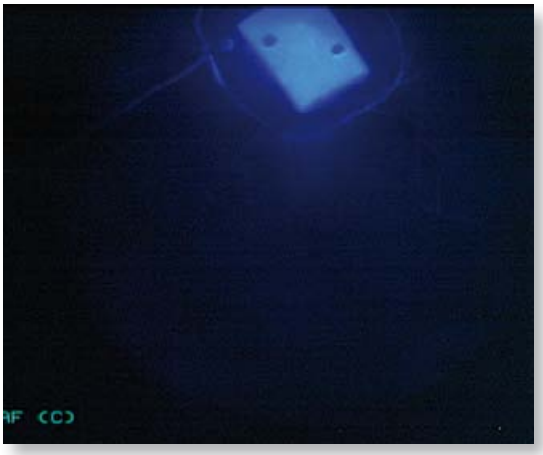

Fig. 2: Endoscopic ICG perfusion assessment – intraoperatively

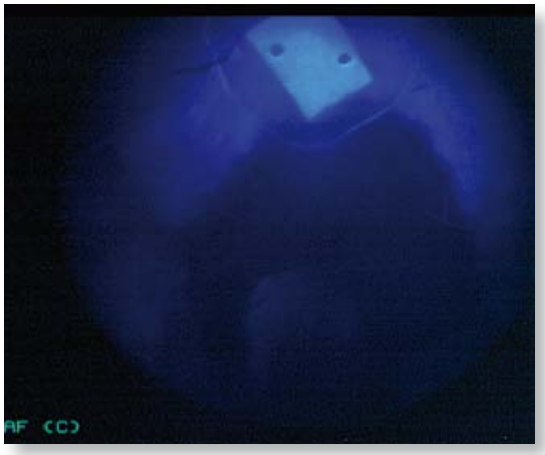

Fig. 3: Endoscopic ICG perfusion assessment – 24 hours after surgery

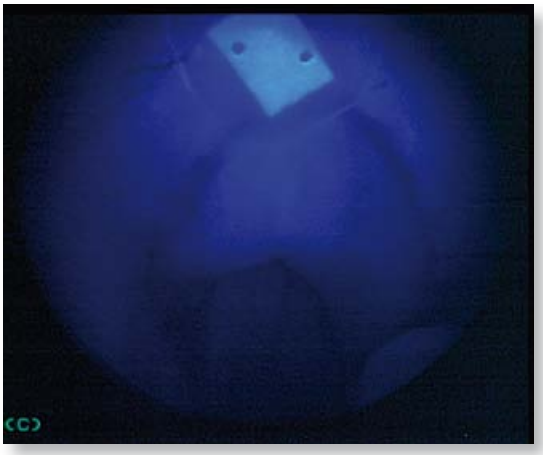

Fig. 4: Endoscopic ICG perfusion assessment – 72 hours after surgery

Results

The collected data were analyzed on a PC online and offline, and the results were compared with clinical results. No partial or complete graft loss occurred. Two grafts with limited perfusion caused by arterial anastomotic insufficiency were salvaged by surgical revision. The endoscopic ICG angiographies were simple to perform and easily tolerated. The grafts exhibited delayed accumulation of the dye, but in the end, accumulation was equal in the grafts and in the surroundings. The two grafts that were initially hypoperfused exhibited relative fluorescence peaks (graft compared to surroundings) of 33% and 37%, respectively, but these values were ≥64% in all further examinations. On the basis of the collected data, we concluded that endoscopic ICG angiographies generally seem useful in patients with free-flap tissue transfer into the upper aerodigestive tract, since this technique is low in risk, easy to perform, and immediately supplies meaningful information on the perfusion status of the tissue. We concluded that the procedure can be a welcome supplement to the other described screening procedures, particularly in difficult situations (unclear Doppler signals, hard-to-see grafts, and hard-to-assess skin color).

Conclusion

As discussed above, the currently available data suggest a broad, useful indication spectrum for endoscopic ICG angiography. This technique seems to be a useful addition or supplement to the currently available range of perfusion-assessing procedures. The newly available instruments are easy to use and work well with existing endoscopic equipment.

Priv.-Doz. Dr. Christian Stephan BETZ
Klinik und Poliklinik für Hals-, Nasen- und Ohrenheilkunde
[Department of otorhinolaryngology]
Munich University Hospital Center, Großhadern campus
Marchioninistr. 15
81377 Munich

Recommended instruments and devices

201337 01-1 **KARL STORZ Cold Light Fountain D-LIGHT P,**
with integrated KARL STORZ SCB, high-power light unit for perfusion control, auto fluorescence, and for standard endoscopic diagnostics, with one 300 Watt Xenon lamp and one
KARL STORZ light outlet.
power supply: 100–125/220-240 VAC, 50/60 Hz
including:
Mains Cord
SCB Connecting Cable
Footswitch, single-pedal, one-stage

202230 11-1 **TRICAM® SL II 3-Chip Camera Control Unit (CCU),** with integrated KARL STORZ SCB and integrated image processing module, PAL/NTSC color system,
power supply: 100–240 VAC, 50/60 Hz
including:
Mains Cord
BNC Connecting Cable, length 180 cm
S-VHS (Y/C) Connecting Cable, length 180 cm
Special RGB Connecting Cable
2 **Connecting Cables** to control video printers
SCB Connecting Cable, length 100 cm
DV Cable, 500 cm
Keyboard, German

202210 37 **TRICAM® PDD 3-Chip Camera Head,**
with 2 freely programmable camera head buttons,
for early photodynamic diagnostics (PDD),
color system PAL, with integrated parfocal zoom lens,
focal length f = 25–50 mm (2x)

8711 AGA **HOPKINS® Straight Forward Telescope 0°**
enlarged view, for perfusion assessment, autofluorescence and white light diagnostics, diameter 10 mm, length 20 cm, autoclavable, fiber optic light transmission and filter wheel incorporated, color code: green

8710 AGA **HOPKINS® Straight Forward Telescope 0°**
enlarged view, for perfusion assessment, autofluorescence and white light diagnostics, diameter 5.8 mm, length 19 cm, autoclavable, fiber optic light transmission and filter wheel incorporated, color code: green

495 FS **Fluid Light Cable,** diameter 2 mm, length 220 cm

Literatur

1 C. Holm, J. Tegeler, M. Mayr, A. Becker, U.J. Pfeiffer, W. Mühlbauer: Monitoring free flaps using laser-induced fluorescence of indocyanine green: a preliminary experience. Microsurgery. 2002; 22; 278-287.K.G.

2 H. Mothes, T. Donicke, R. Friedel, M. Simon, E. Markgraf, O. Bach: Indocyanine-green fluorescence video angiography used clinically to evaluate tissue perfusion in microsurgery. Journal of Trauma. 2004; 57; 1018-1024.

3 Krishnan, G. Schackert, R. Steinmeier: The role of near-infrared angiography in the assessment of post-operative venous congestion in random pattern, pedicled island and free flaps. British Journal of Plastic Surgery. 2005; 58; 330-338.

4 C. Holm, U. Dornseifer, G. Sturtz, M. J. Ninkovic: Sensitivity and specificity of ICG angiography in free flap reexploration. Reconstructive Microsurgery 2010;26;311-316.

5 C. S. Betz, S. Zhorzel, H. Schachenmayr, H. Stepp, M. Havel, V. Siedek, A. Leunig, C. Matthias, C. Hopper, U. Harréus: Endoscopic measurements of free-flap perfusion in the head and neck region using red-excited Indocyanine Green: preliminary results. Journal of Plastic, Reconstructive and Aesthetic Surgery 2009;62;1602-1608.

6 C. S. Betz, S. Zhorzel, H. Schachenmayr, U. Harréus: Prospektive, diagnostische Machbarkeitsstudie zur endoskopischen Gewebeperfusionsmessung freier Gewebetransplantate in der Kopf-Hals-Region unter Verwendung von rot angeregtem Indocyanin-Grün. In: Deutsche Gesellschaft für Hals-Nasen-Ohren-Heilkunde, Kopf- und Hals-Chirurgie: 80. Jahresversammlung der Deutschen Gesellschaft für Hals-Nasen-Ohren-Heilkunde, Kopf- und Hals-Chirurgie, Rostock 2009; German Medical Science GMS Publishing House; Düsseldorf; Doc09hnod527.

7 K. Okamoto, N. Muguruma, T. Kimura, H. Yano, Y. Imoto, M. Takagawa, M. Kaji, R. Aoki, Y. Sato, S. Okamura, Y. Kusaka, S. Ito: A novel diagnostic method for evaluation of vascular lesions in the digestive tract using infrared fluorescence endoscopy. Endoscopy 2005;37;52-57.

8 T. Kimura, N. Muguruma, S. Ito, S. Okamura, Y. Imoto, H. Miyamoto, M. Kaji, E. Kudo: Infrared fluorescence endoscopy for the diagnosis of superficial gastric tumors. Gastrointestinal Endoscopy 2007;66;37-43.

9 S. Imizu, Y. Kato, A. Sangli, D. Oguri, H. Sano: Assessment of incomplete clipping of aneurysms intraoperatively by a near-infrared indocyanine green-video angiography (Niicg-Va) integrated microscope. Minimally Invasive Neurosurgery 2008;51;199-203.

10 T. Carus, H. Lienhard: Die laparoskopische Fluoreszenzangiographie mit Indocyaningrün zur intraoperativen Beurteilung der Perfusion bei kolorektalen Anastomosen. In: Deutsche Gesellschaft für Chirurgie: Chirurgisches Forum und DGAV Forum 2009; Springer; Berlin, Heidelberg; SN 978-3-642-00625-8;331-333

ENDOWORLD®

WWW.KARLSTORZ.COM

KARL STORZ GmbH & Co. KG
Mittelstraße 8, 78532 Tuttlingen, Germany
Postbox 230, 78503 Tuttlingen, Germany
Phone: +49 (0)7461 708-0
Fax: +49 (0)7461 708-105
E-Mail: info@karlstorz.de
www.karlstorz.com

KARL STORZ Endoscopy-America, Inc.
2151 East Grand Avenue
El Segundo, CA 90245-5017, USA
Phone: +1 424 218-8100
Phone toll free: 800 421-0837 (US only)
Fax: +1 424 218-8525
Fax toll free: 800 321-1304 (US only)
E-Mail: info@ksea.com

STORZ
KARL STORZ — ENDOSKOPE
THE DIAMOND STANDARD

EW ENT 122-E/07-2011